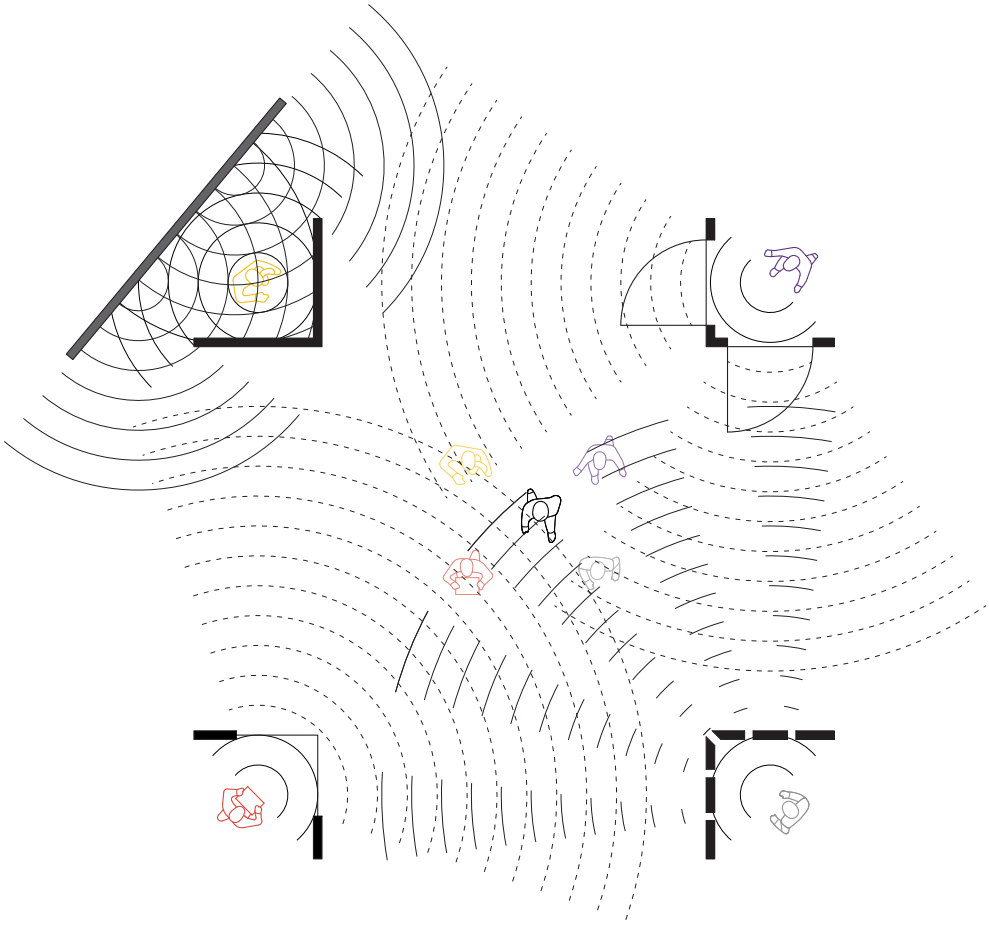
The Spaces We Hear



RICE UNIVERSITY

The Spaces We Hear

by

Michael Kapinus

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

Master of Architecture

APPROVED, THESIS COMMITTEE:

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Professor of Architecture,
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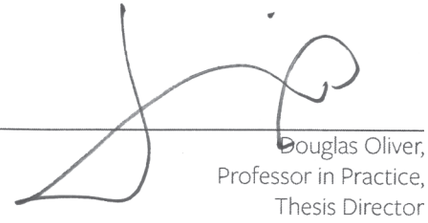

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Acknowledgments

There are several people who have guided me throughout my architectural education, and ultimately made this thesis possible, through their generosity and support.

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Abstract

All spaces have acoustic qualities. Once space is occupied and an event takes place, the event and the acoustics produce an aural environment. This aural environment has a strong impact on space and how it is experienced. This project takes into account the aural environment from the beginning of the design process. Using it to cross spaces, to create new spaces, and create new relationships between spaces – to let sound become an organizer of space and a creator space. This project uses the aural environment as a positive architectural tool – an architectural tool not only of acoustics, but one of an overall soundscape, fostering the relationship between the public and private, and the variances of the aural environment in between.

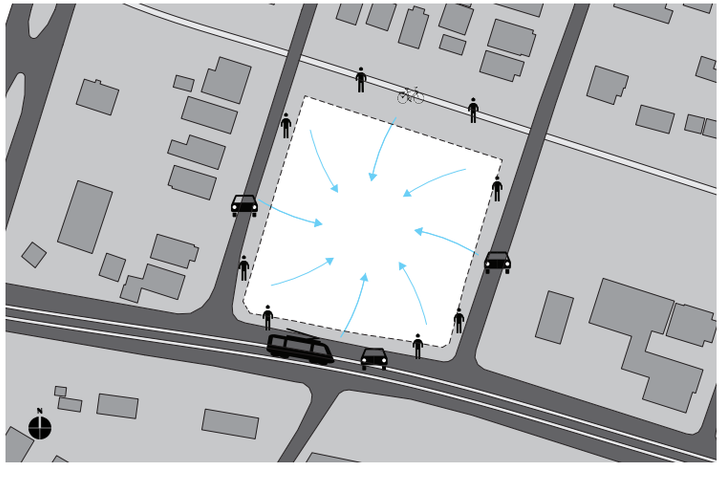
Table of Contents

Exposition

The program for the project is a drug and alcohol rehabilitation center and community wellness center. It provides a variety of spaces, each with their unique acoustic qualities and aural environments. It includes live in treatment as well as outpatient counseling and treatment for the community at large with doctor, counseling, and social work services. There are open classrooms and general meeting spaces and the center fosters wellness in the community with shared spaces available to the public including recreation/exercise areas, pool, cafeteria, outdoor space and larger hall for education, lectures and community meetings. The experience becomes one of spaces differentiated by their aural environments in an overall soundscape – one of openness and multiplicity conducive to the challenges of social and physical rehabilitation and reintegration – rather than a feeling of isolation often found in rehabilitation, it's one of inclusion and community.

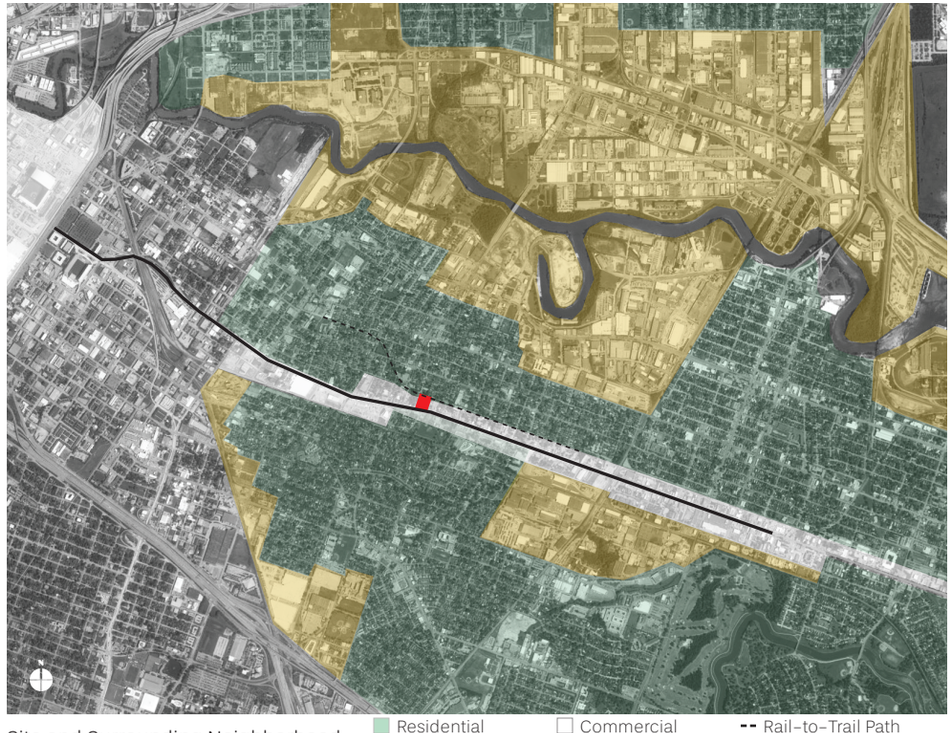
Site

The site sits on the border of the Eastwood neighborhood and the 2nd Ward of Houston, just east of downtown. It sits on a major downtown artery with a growing commercial presence, with light rail to the south and a rail to trail path to the north and residential arteries to the east and west. It is surrounded by a large middle and lower-middle class neighborhood.



Central Houston – Inner Loop

Eastwood Neighborhood



Site and Surrounding Neighborhood

Residential
Industrial
Commercial
Rail-to-Trail Path
Light Rail

Program

Private Program

Residences	
6 Single Occupancy Rooms	750 sf
6 Double Occupancy Rooms	1200 sf
Bathrooms	400 sf
Nurse's Station and Storage	300 sf
2 Administration Offices	200 sf
Lounge	600 sf
Treatment Offices	
4 Examination Rooms	750 sf
6 Consultation Offices	600 sf
Nurse's Station and Administration	500 sf
Storage	100 sf
Bathroom	100 sf
Waiting Areas	350 sf
Pool Changing/Restrooms	
Locker/Changing	1000 sf
Showers	500 sf
Bathrooms	500 sf
Waiting Area	250 sf
Outdoor Recreation/Meditation Area	400 sf
Cafeteria	1500 sf

Public Program

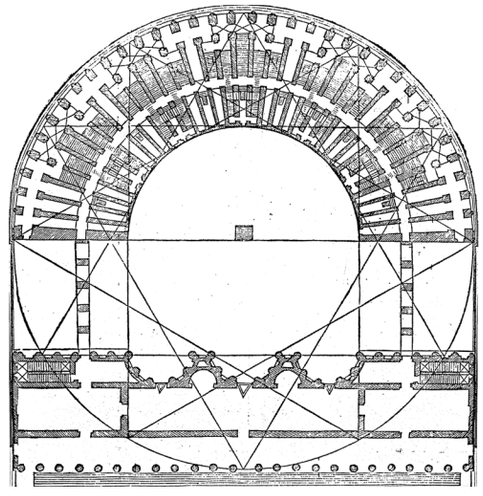
2 Classrooms	2400 sf
2 Meeting/Multipurpose Rooms	2800 sf
Reception and Waiting/Lounge Area	2200 sf
Pool	8000 sf
Cafeteria	3600 sf
Outdoor Courtyard	2400 sf
Lecture/Performance Hall	1600 sf

Total Assignable	
33000 sf	
Circulation and Mechanical	
7000 sf	
Total Buildable Area	
40000 sf	

Site Dimensions

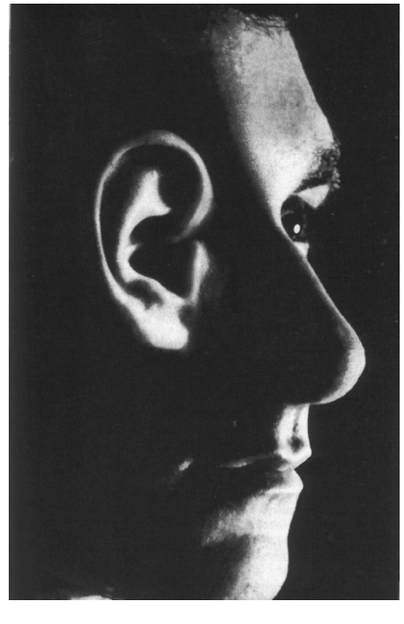
Prelude

Of course sound and acoustics are not new to the architectural discipline. Vitruvious, in an age when oral communication still dominated, saw the need for formal acoustic treatments and resonators to enhance the aural environment in theaters, showing a knowledge of basic acoustical concerns in architecture. The eighteenth and nineteenth century earned a greater mathematical understanding of acoustics, enhancing the architects tools in augmenting the aural environment. And the mid 20th century, along with its technological boom, led to new experimentation with sound and amplification and architectural form in works by architects like Corbusier and Xenakis, and Bernhard Leitner. Macluhan thought new media would bring visual and aural communication back onto a level playing field, with new types of acoustic space. And in 1970, R. Murray Schaefer, a composer and writer who coined the term "soundscape", believed 'Acoustic Design' would become the next big discipline to emerge in schools of architecture. However, today, sound and acoustics in architecture has been relegated simply to negation - using acoustics simply for reduction, isolation and absorption.



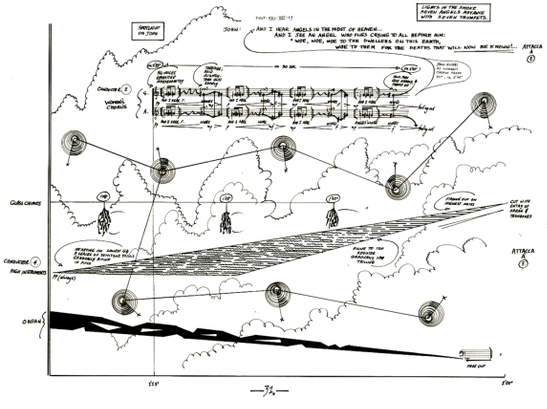
"...the voice, uttered from the stage as from a centre, and spreading and striking against the cavities of the different vessels, as it comes in contact with them, will be increased in clearness of sound, and will wake an harmonious note in unison with itself." - Vitruvius, *De architectura,* Book 5, Chapter 5, c. 15 B.C.

Nineteenth century halls improved remarkably with an improved basic knowledge reflection, reverberance , and proportion with a "rectangular shape, flat or gently sloping floors and elevated orchestra platforms, ornamented wall surfaces available to create multiple reflections, highly diffusive ceilings and a strong ability of the orchestra to hear itself." - Marshall Long, *Acoustics Today*, 2009



"Until writing was invented, man lived in acoustic space: boundless, directionless, horizonless, in the dark of the mind, in the world of emotion... We hear sounds from everywhere, without ever having to focus. Sounds come from "above," from "below," from in "front" of us, from "behind" us, from our "right," from our "left." We can't shut out sound automatically. We simply are not equipped with earlids. Where a visual space is an organized continuum of a uniformed connected kind, the ear world is a world of simultaneous relationships." - Marshall McLuhan, *The Medium is the Massage*, 1967

"The collision of hail or rain with hard surfaces, or the song of cicadas in a summer field. These sonic events are made out of thousands of isolated sounds; this multitude of sounds, seen as totality, is a new sonic event." - Iannis Xenakis, *Formalized Music: Thought and Mathematics in Composition*, 1971

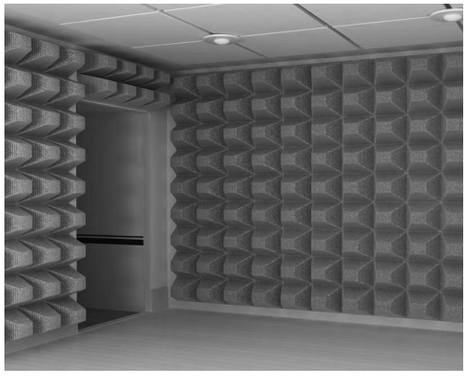


"Today all sounds belong to a continuous field of possibilities lying within the comprehensive dominion of music. Behold the new orchestra: the sonic universe! And the musicians: anyone and anything that sounds!" - R. Murray Schafer, *The Soundscape*, 1977

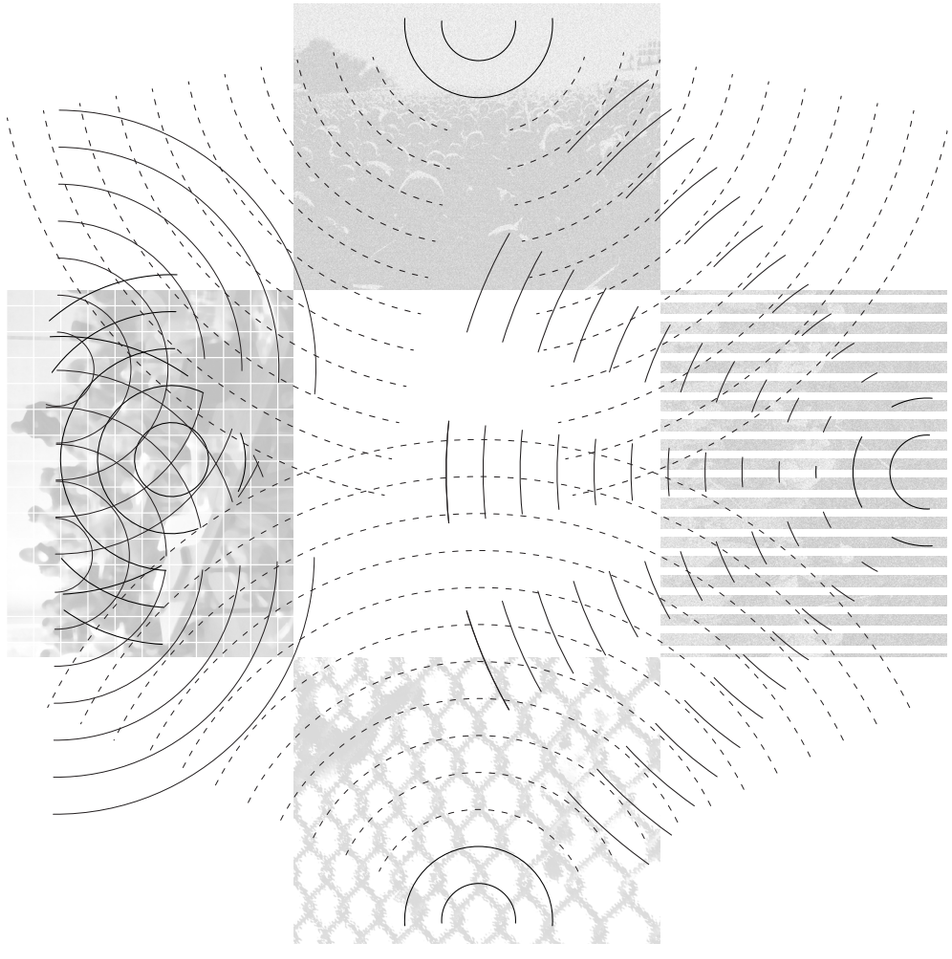
"It is necessary to rethink and redefine the term "space". The boundaries of these spaces cannot be experienced at once, and they are not "dynamic, fluid" spaces in the conventional interpretation. It is space which has a beginning and an end. Space is here a sequence of spatial sensations – in its very essence an event of time. Space unfolds in time; it is developed, repeated and transformed in time." - Bernhard Leitner, *Soundspace Manifesto*, New York, 1977

Status Quo

However, today, sound and acoustics in architecture has been relegated to purely musical applications or simply to negation - using acoustics simply for reduction, isolation and absorption. The majority of attention is concentrated on getting rid of unwanted sounds.



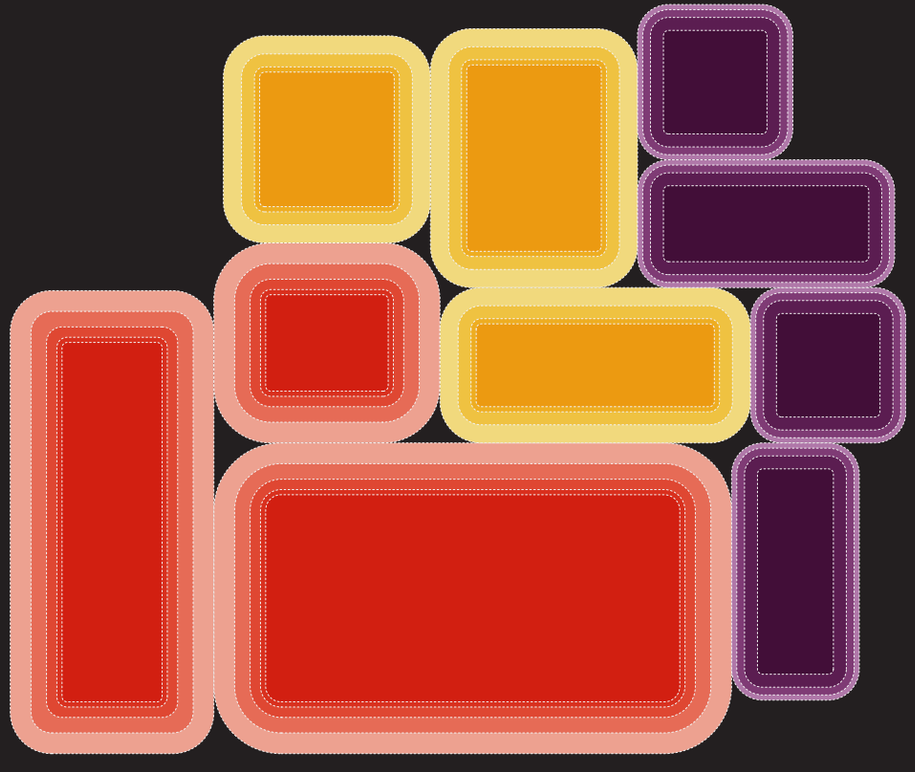
Development



Composition

This project uses the aural environment as a positive architectural tool – an architectural tool not only of acoustics, but one of an overall sound-scape, fostering the relationship between the public and private, and the variances of the aural environment in between. It's not simply a question of the science of acoustics, but one of composition. By forming aural spaces and zones, the sonic event and its temporality become more important. Much like any building, spaces become shaped through their structured and unstructured public uses, their private uses and smaller structured events.

Plan of Program and Aural Zones: Degrees of Sonic Event



Strong Sonic Events

Unstructured Average Sonic Events

Structured Weaker Sonic Events

Plan of Program and Aural Zones: Composition of Events

Strong Sonic Events

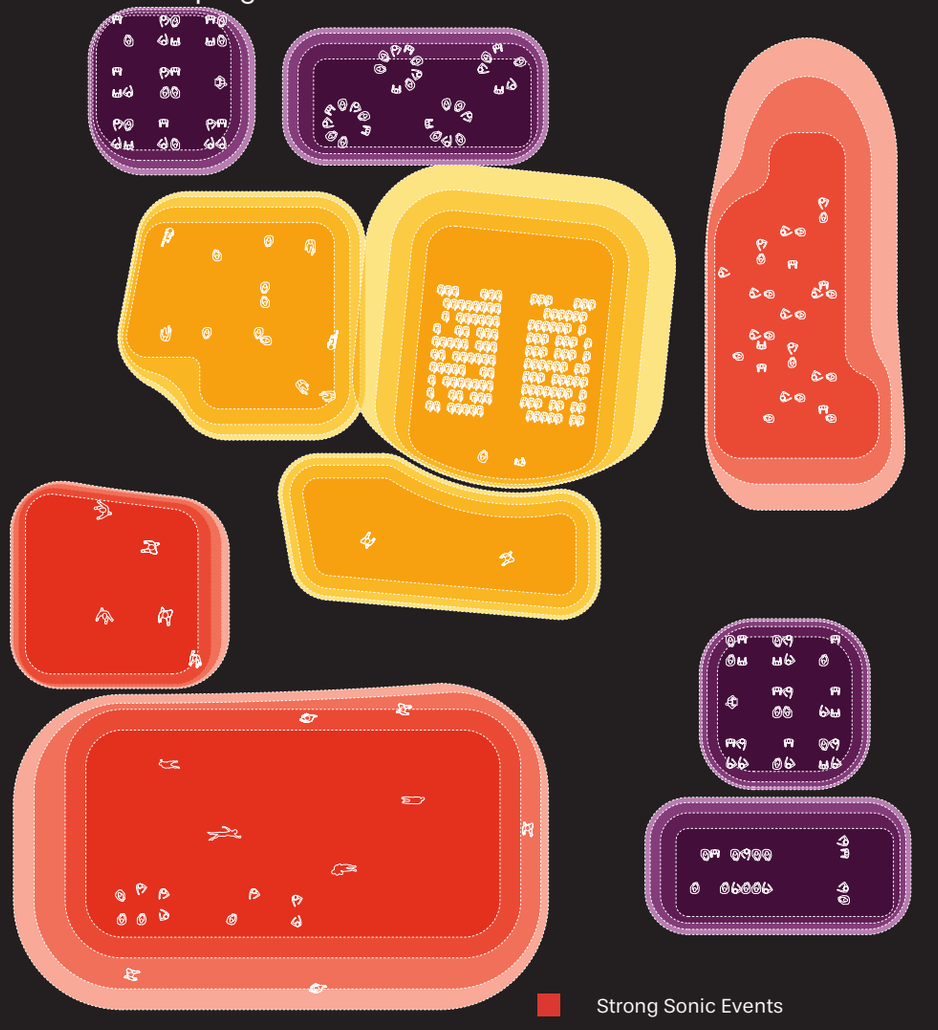
Unstructured Average Sonic Events

Structured Weaker Sonic Events

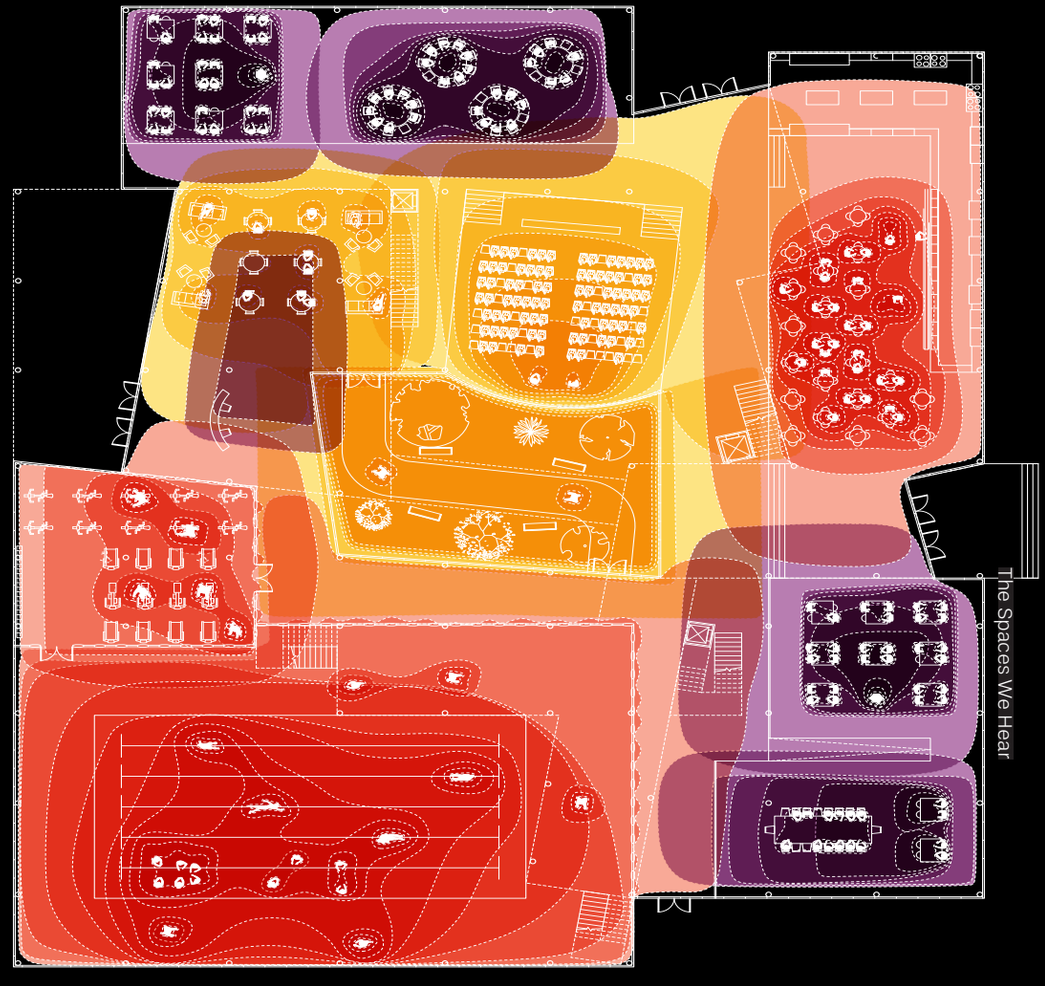
The experience is a more holistic or encompassing phenomenological experience with varying spaces, with varying degrees of weak or strong visual identities and weak or strong sonic identities. All of which is being experienced by the occupant whether in a particular or singular aural space or whether experiencing more when in circulation. Areas of strong sonic overlap present an environment of multiplicity, of occupancy and activity. Areas present opportunities of responsive space and sonic involvement. Each playing into the composition of the overall soundscape.

However, aural spaces also present varying degrees of sonic events. Certain events produce a strong sonic event, easily identified, while others produce a weak sonic event, while others may be distracting or uninformative. These all come into play in the composition of the overall aural environment.

Plan of Program and Aural Zones: Acoustic Shaping



Plan of Program and Aural Zones: Formation of Full Sonic Plan with Bleeds



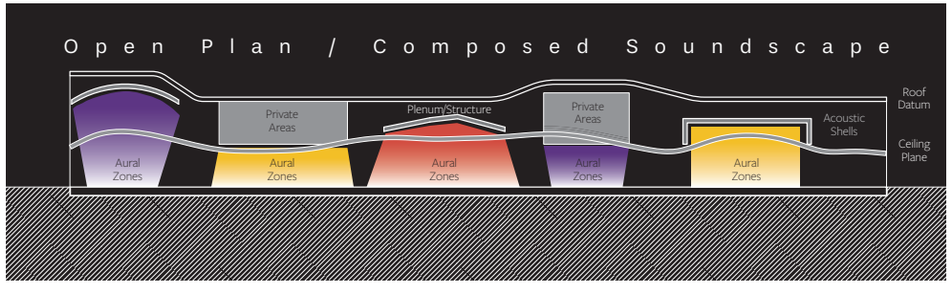
Michael Kapinus

Organization and form begin to take shape through the consideration of these zones and the encompassing events. These events, people and furniture represent space and create the soundscape. Acoustic necessities, formal interventions, and material markers form around these events to shape the building.

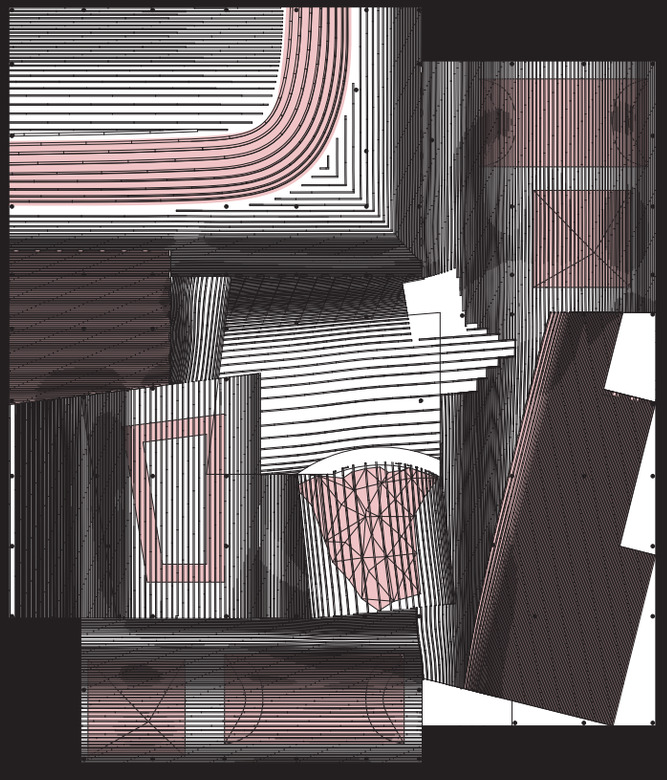
The experience is a more holistic or encompassing phenomenological experience with varying spaces, with varying degrees of weak or strong visual identities and weak or strong sonic identities. All of which is being experienced by the occupant whether in a particular or singular aural space or whether experiencing more when in circulation. Areas of strong sonic overlap present an environment of multiplicity, of occupancy and activity. Areas present opportunities of responsive space and sonic involvement. Each playing into the composition of the overall soundscape.

Progression

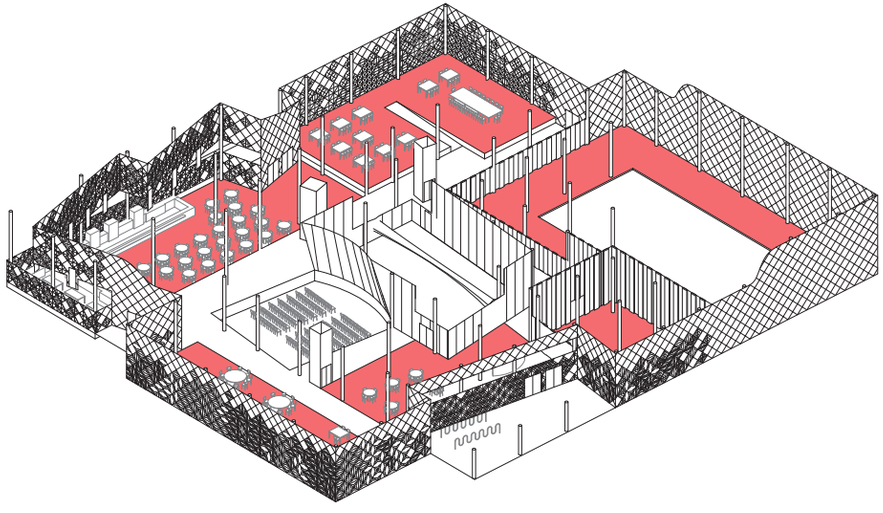
Active public areas, each with their own acoustic treatments, have their own specific aural environments. Environments of activity and community. In this project, the ceiling becomes the primary apparatus for controlling the aural environment, allowing for an open plan and an unencumbered soundscape. A thickened ceiling/plenum zone is under constant manipulation to form aural spaces, sometimes dropping to create more intimate spaces and low sonic transference; sometimes extending up, piercing through the top, forming more expansive aural zones that can spill into public spaces and circulation zones, creating new crossover spaces. Form and material in the ceiling, as well as the floor define programmatic areas through their aural environments first, and through visual means secondary. Spaces needed for absolute privacy are raised within the roof zone, not to a second floor, but lofted into this manipulated space. A place where visual opacity may be limited, but aural transference can still be exploited. The connective ceiling plane through circulation areas undulates with the change in elevation and section for the various acoustic shells and aural zones, sometimes dipping for intimate areas and sometimes extending, pushing the roof upward for larger expansive zones.



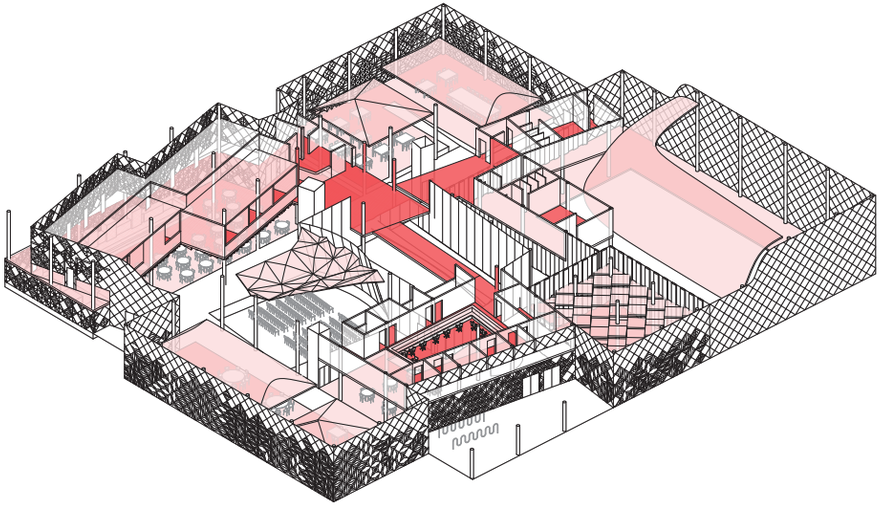
Reflected Ceiling Plan



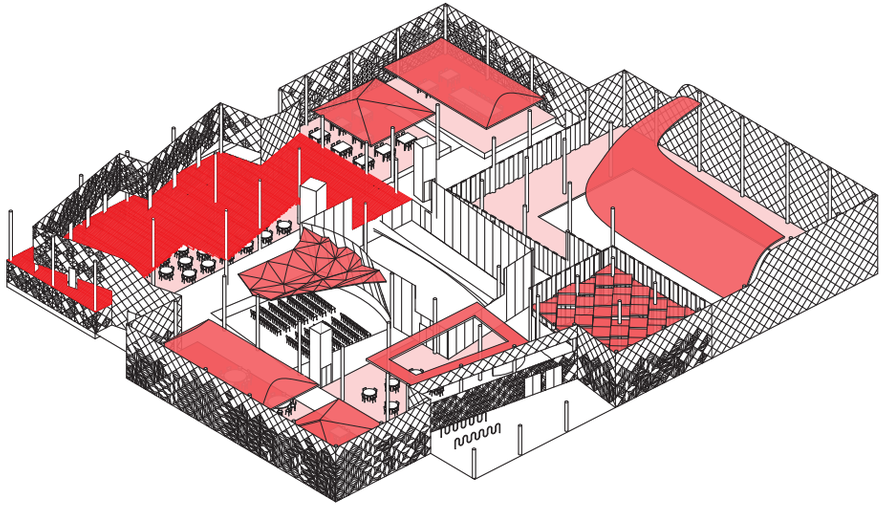
The wood paneling expands and contracts and sometimes changes directions, giving shape to the aural zones, aiding in the acoustic attenuation. It may open to let sound through to be absorbed by insulating materials, or it may be reflected back from an acoustic shell. Sometimes it contracts to be the acoustically reflective material itself, or in connection with the acoustics, it gives a kind of visual direction to a circulation area.



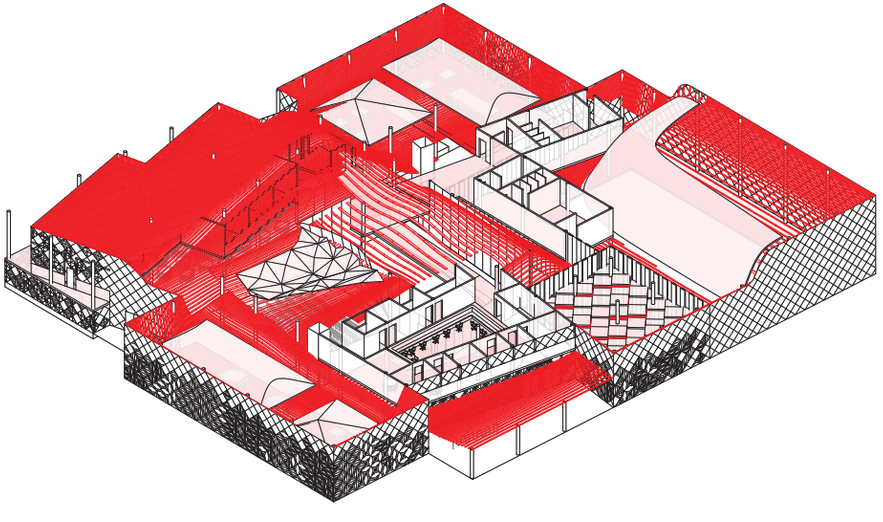
Floor materials and sectional shifts begin to mark aural zones visually and through acoustic properties.



The treatment offices and residences are lofted into a mezzanine where they can be afforded privacy but can still participate in the aural environment.



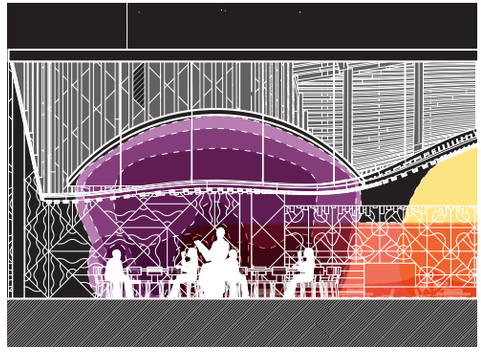
Acoustic forms or shells refine spaces and form aural zones and allow or inhibit degrees of participation in the overall soundscape.



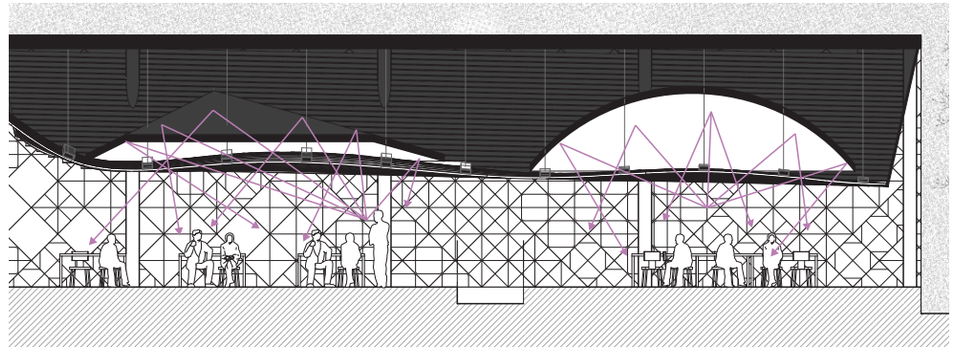
The panelized ceiling plane connects the zones, changing scale and direction to further demarcate circulation and further control bleeds and transference between all spaces.

Shaping

For more intimate activities, sound is reflected inward and absorbed or even actively attenuated to create a more singular space while allowing for minimal bleed.

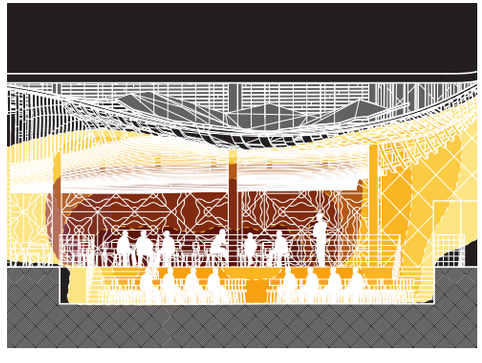


Meeting Area Aural Zone

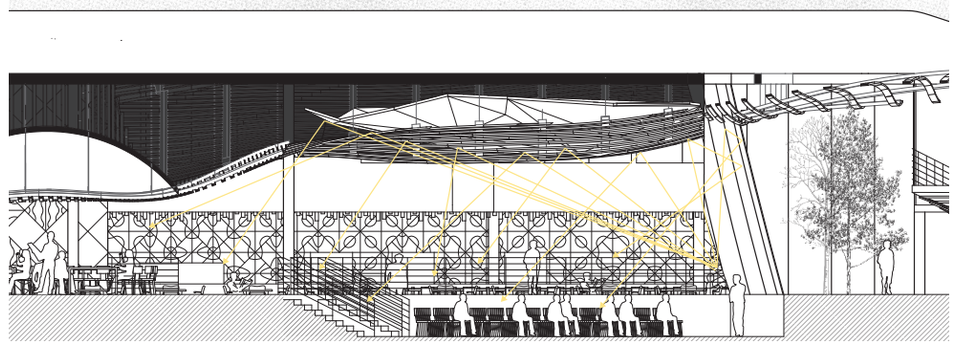


Meeting Area Sound Reflections

The lecture/meeting area shifts down to give its users an enveloped zone while its aural activity is reflected to neighboring circulation and public zones.

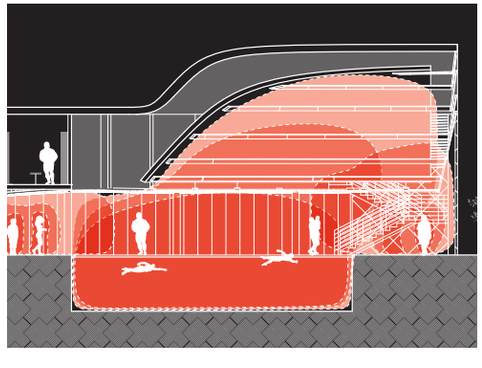


Lecture/Performance Aural Zones

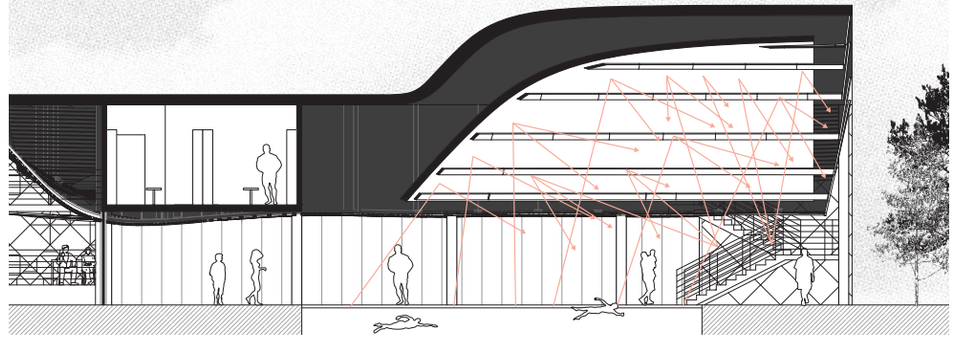


Lecture/Performance Sound Reflections

The raised shell of the pool allows for the heightened activity and reflects the majority of noise away from the rest of the building.



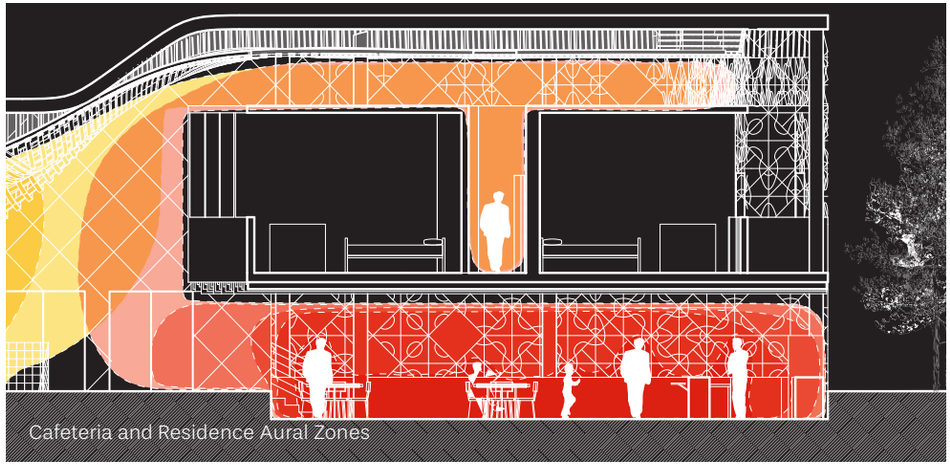
Swimming Pool Aural Zone



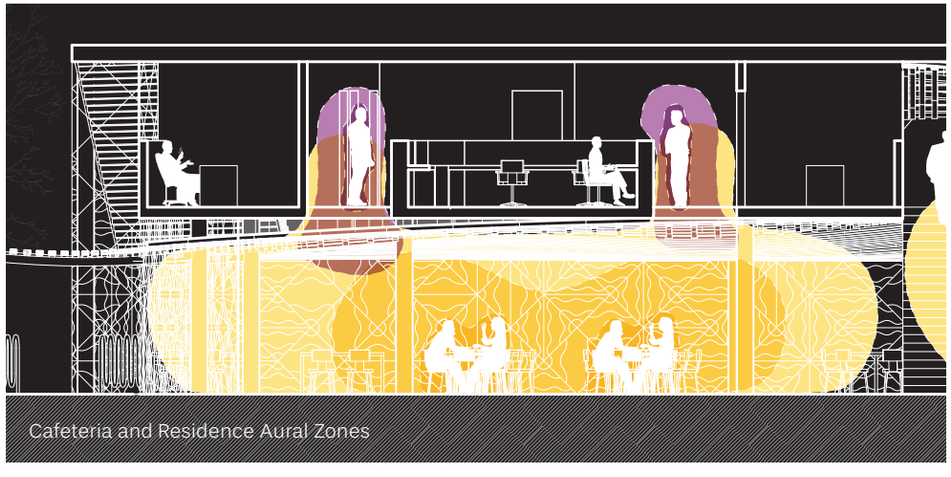
Swimming Pool Sound Reflections

Indirect Communication

For more private areas, transference can occur without a visual connection – through reflection, vibration and opaque materials that transfer sound. It creates a sharing of space that may not be whole, but still of a mutual experience. It might surround an occupant within an aural environment, or bring that environment to them, which they may not be able to physically occupy. It creates a new space of aural activity within another space and the separation becomes less physical, but a play between the visual, or lack thereof, and the aural.



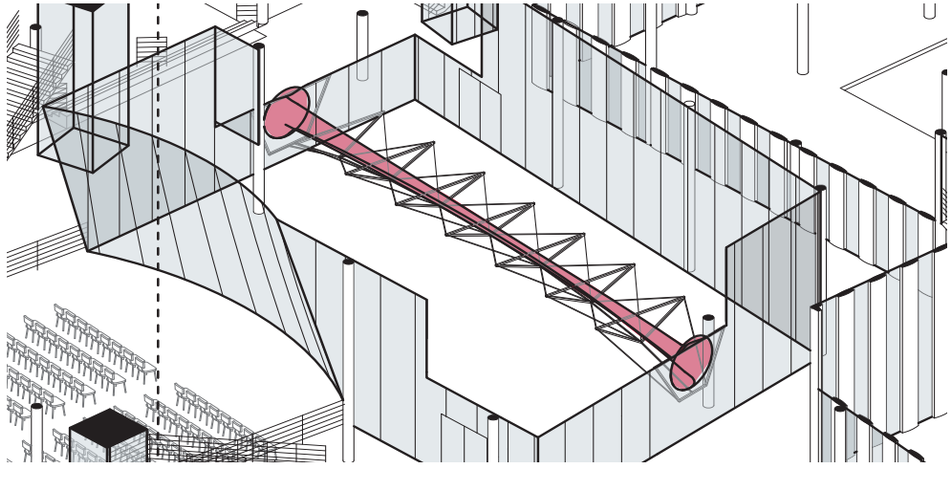
In the residences lofted into the mezzanine, sounds wafts above to its circulation zones from the lecture hall and cafeteria..



In the treatment circulation and waiting area the floor uses muted transference and vibration to communicate activity above and below, a type of communicative sounding board.

Divisions that are needed by necessity are dynamic and active. Whether the source or the receiver or both are in motion, the sense of motion and activity is heightened both visually and aurally.

The pool area, which must stay environmentally controlled, uses a staggered division of glass and translucent panels that sets an aural environment in motion.



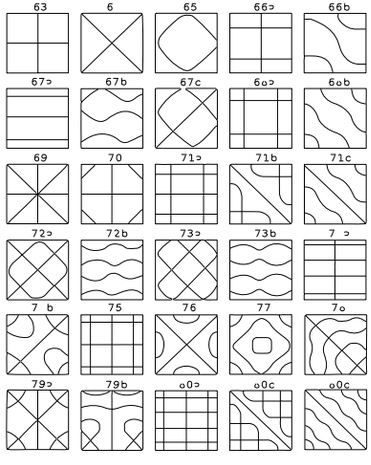
A sound tube stretches under the courtyard walkway, aurally connecting the east and west main entrances separated by the courtyard.

It's an holistic experience of changing environments and spatial occupation, that creates interactions sometimes visual, sometimes aural, and sometimes in between. It allows for a changing meaning of public and private, active and quiet, and allows for different and new relationships between aural and visual spaces.

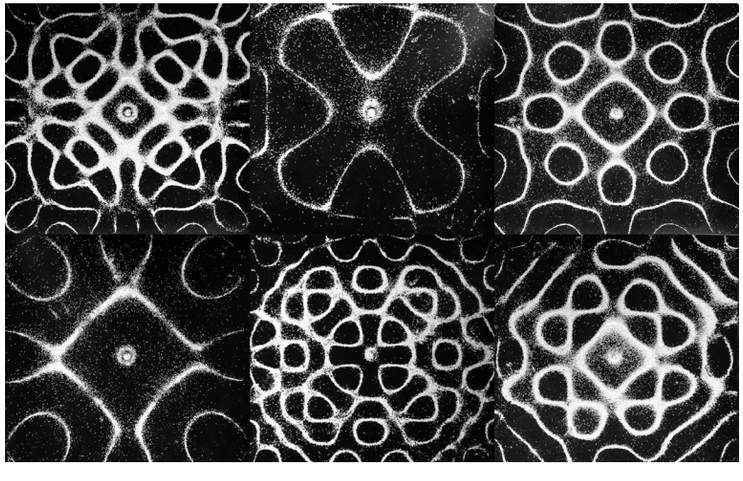
Facade

The façade is equally dynamic. Ornamental patterns are formed on the façade through dampening materials within the glass. The patterns originate from Chladni patterns – natural patterns that form on a sand covered plate that is bowed or electronically resonated at different tones. These patterns can be tiled, often several similar ones together, to form larger patterns. These patterns surround programmatic areas that need more aural protection from the outside environment or less internal vibration and reflection.

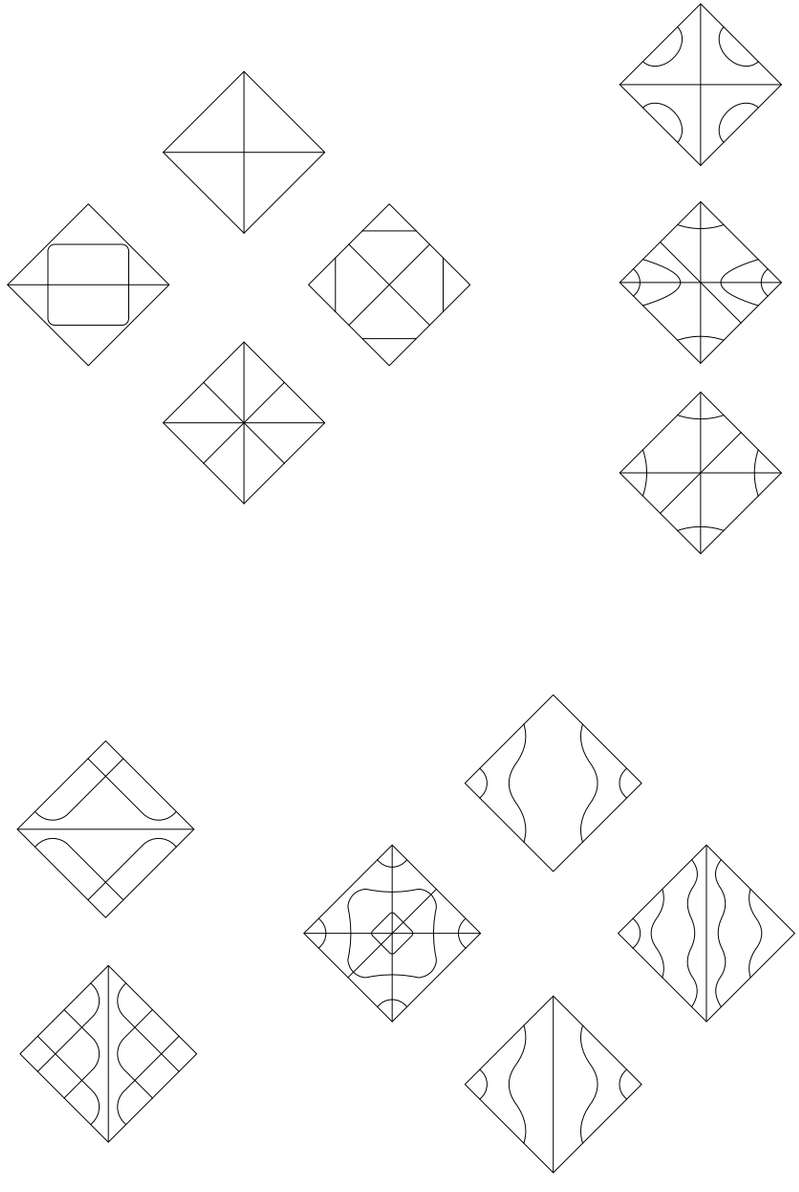
Chladni Plate



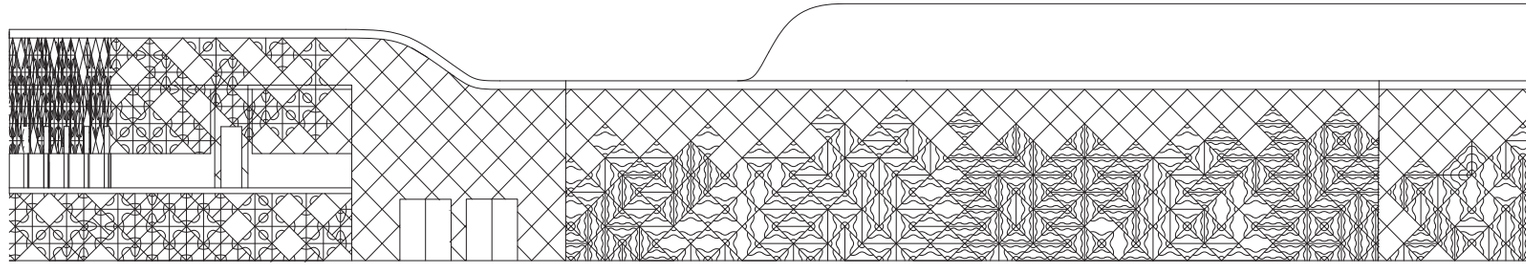
Sampling of Chladni Patterns



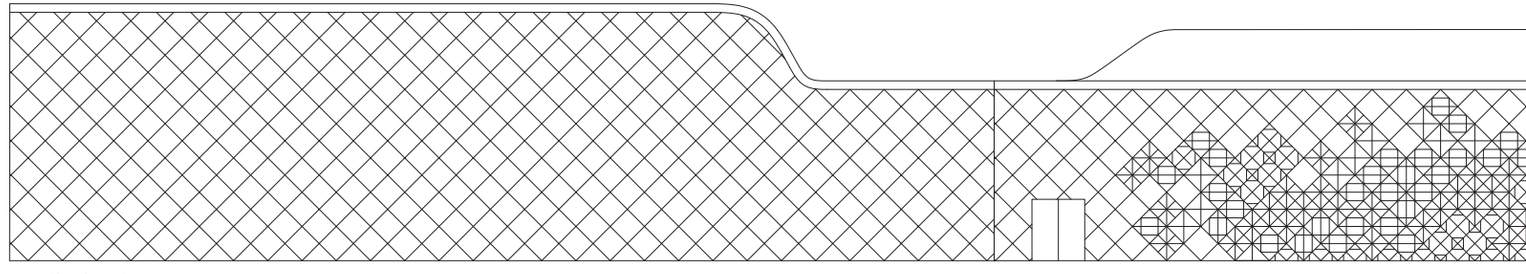
Chladni Patterns Used for Facade



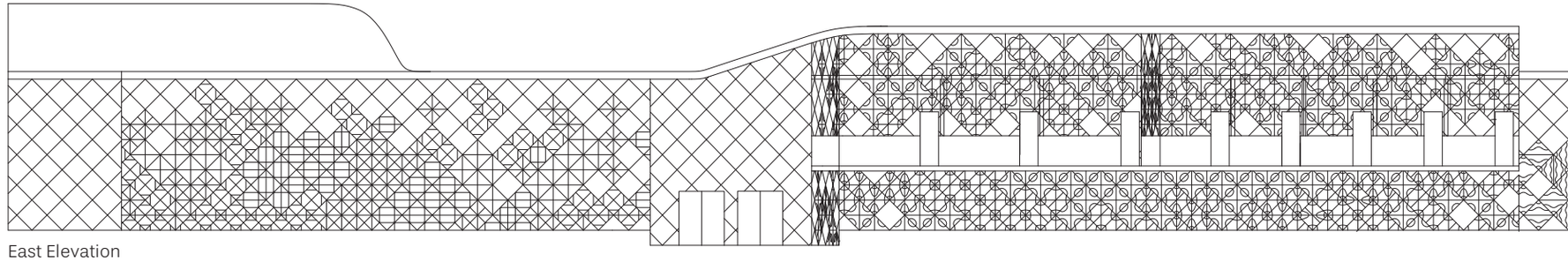
Facade Elevations



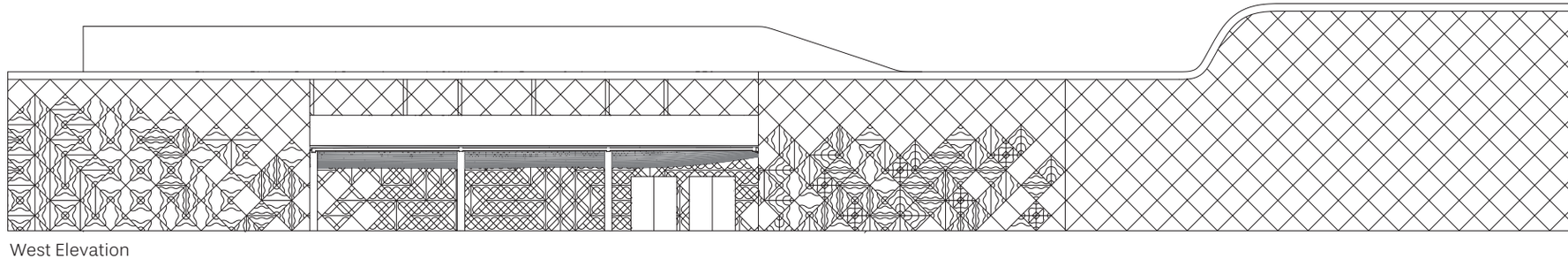
North Elevation



South Elevation

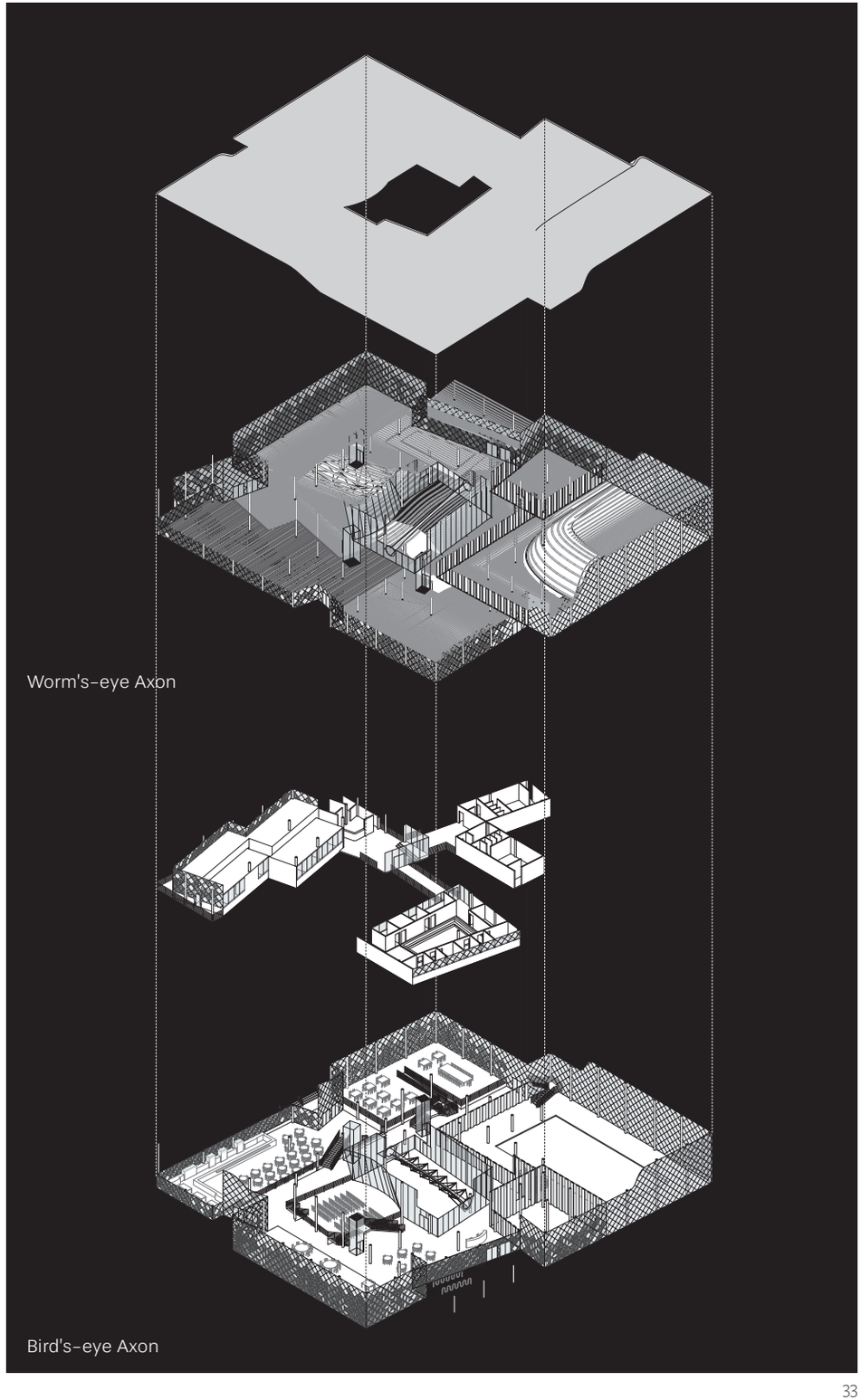


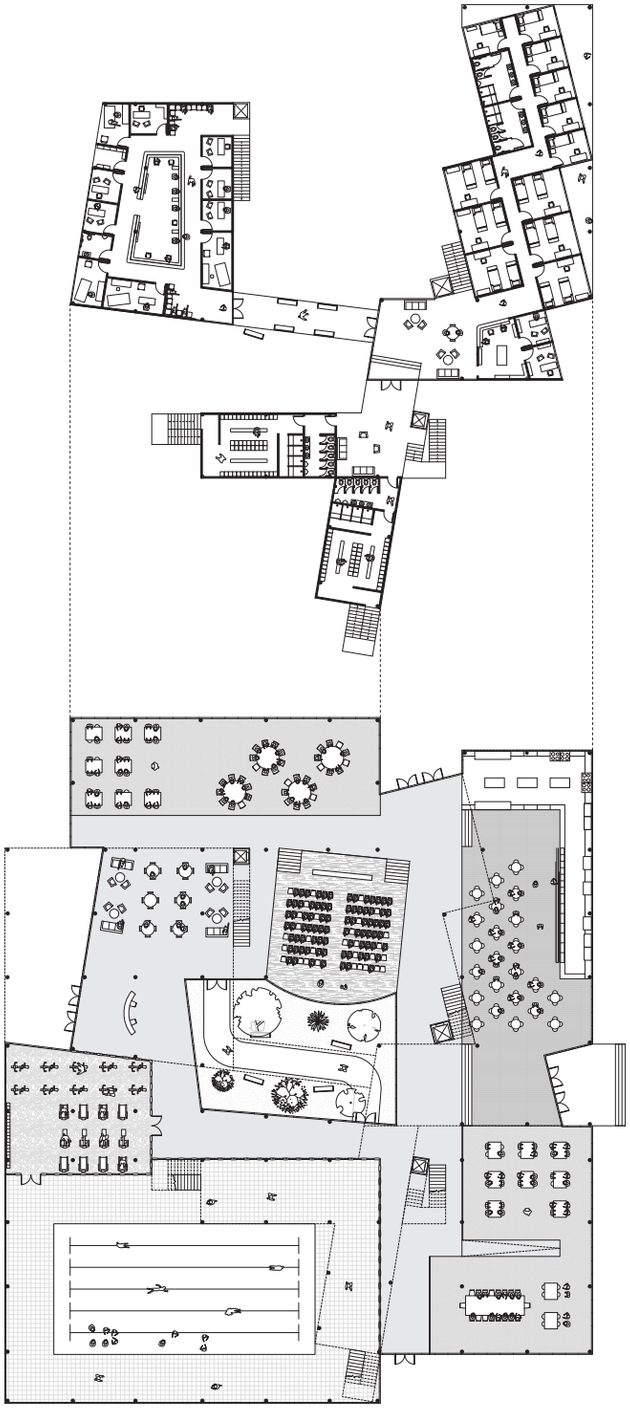
East Elevation



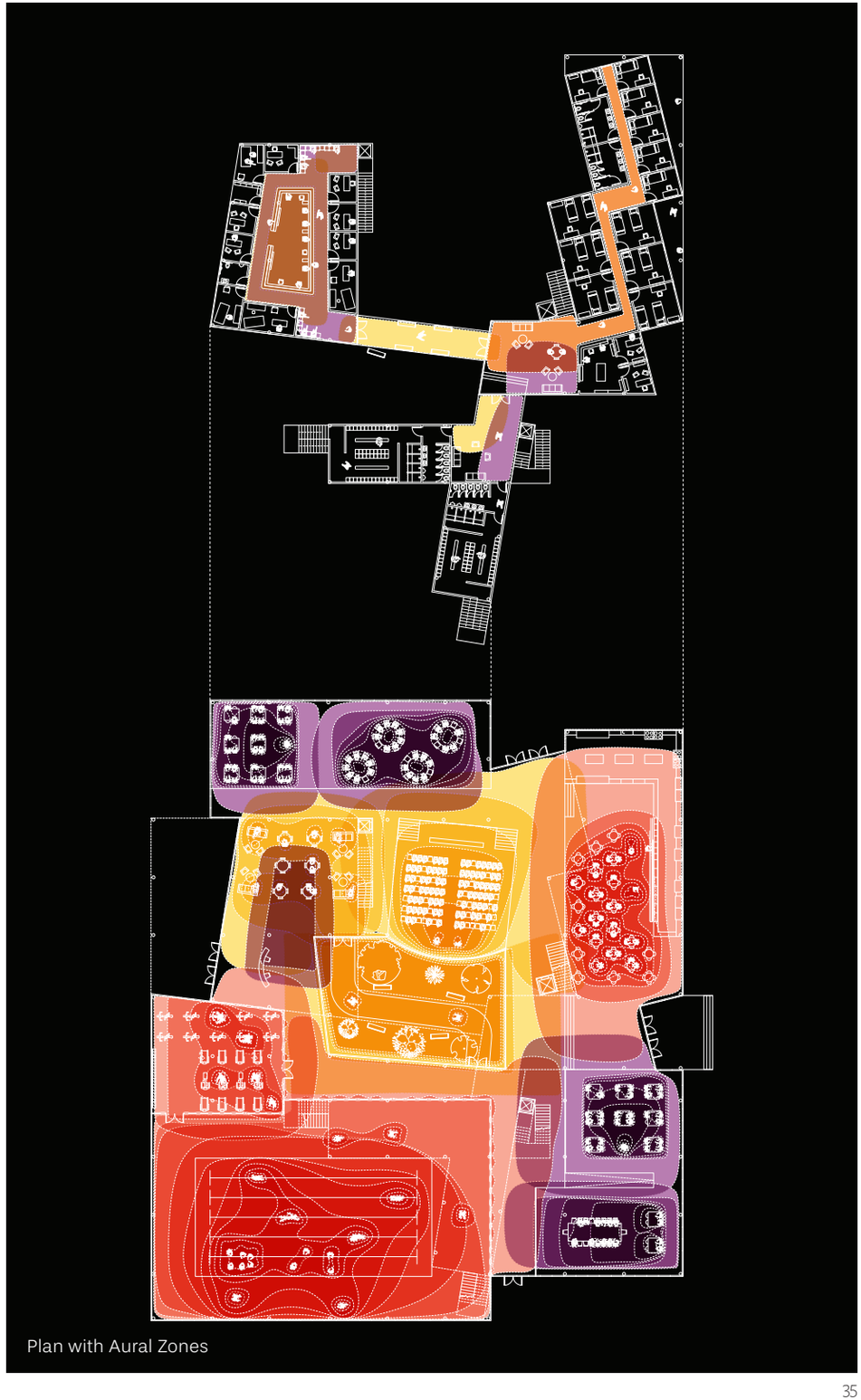
West Elevation

Notation

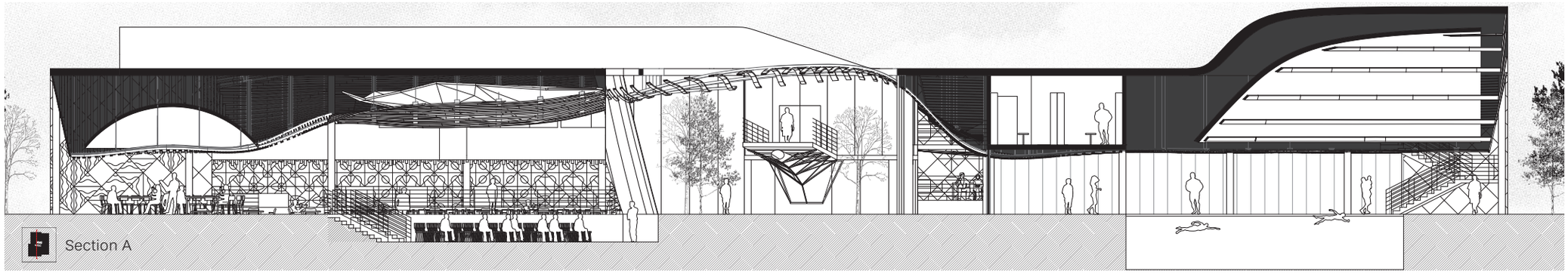




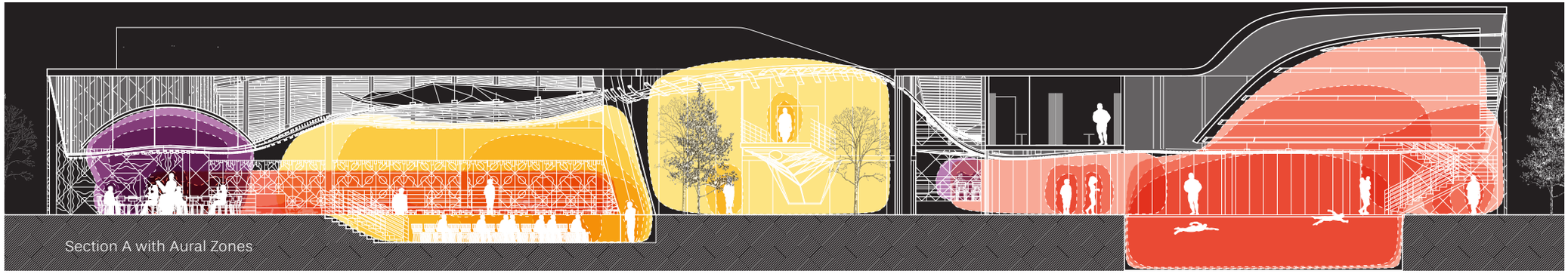
Plan



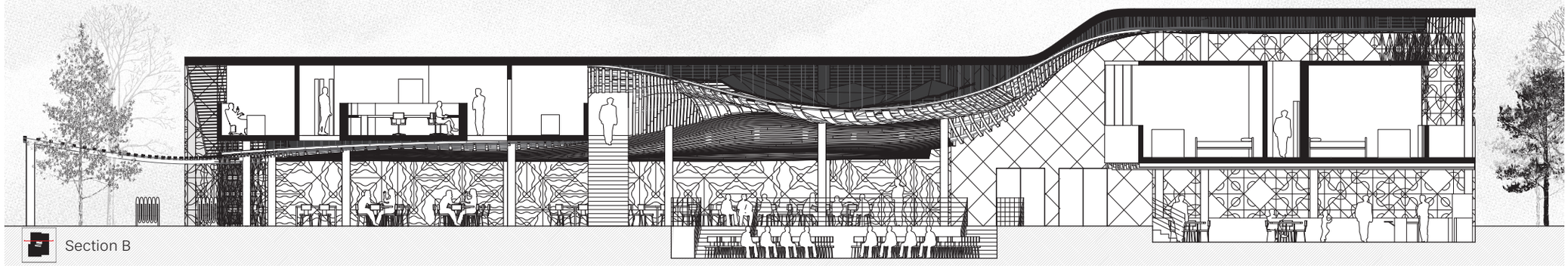
Plan with Aural Zones



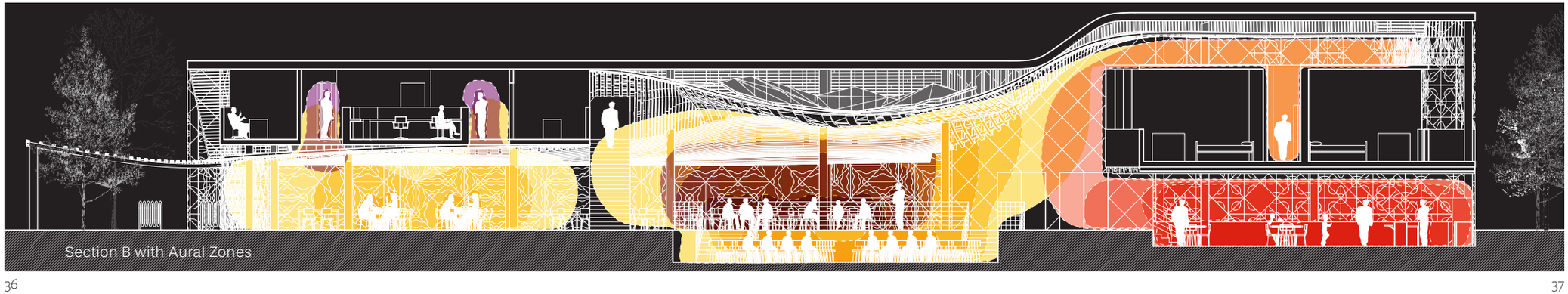
Section A



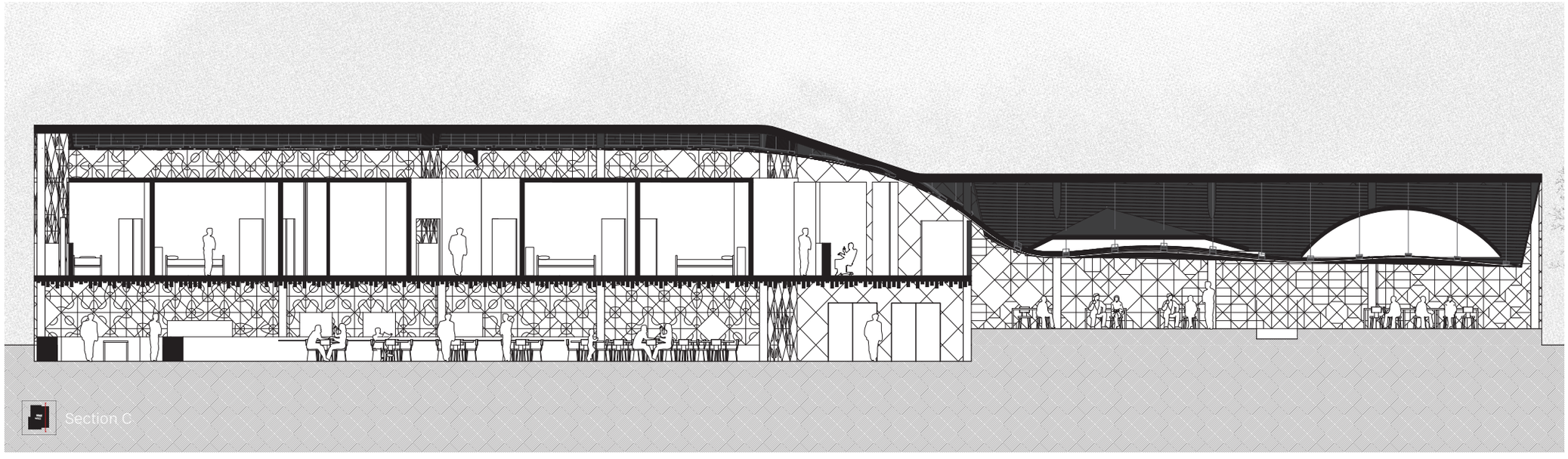
Section A with Aural Zones

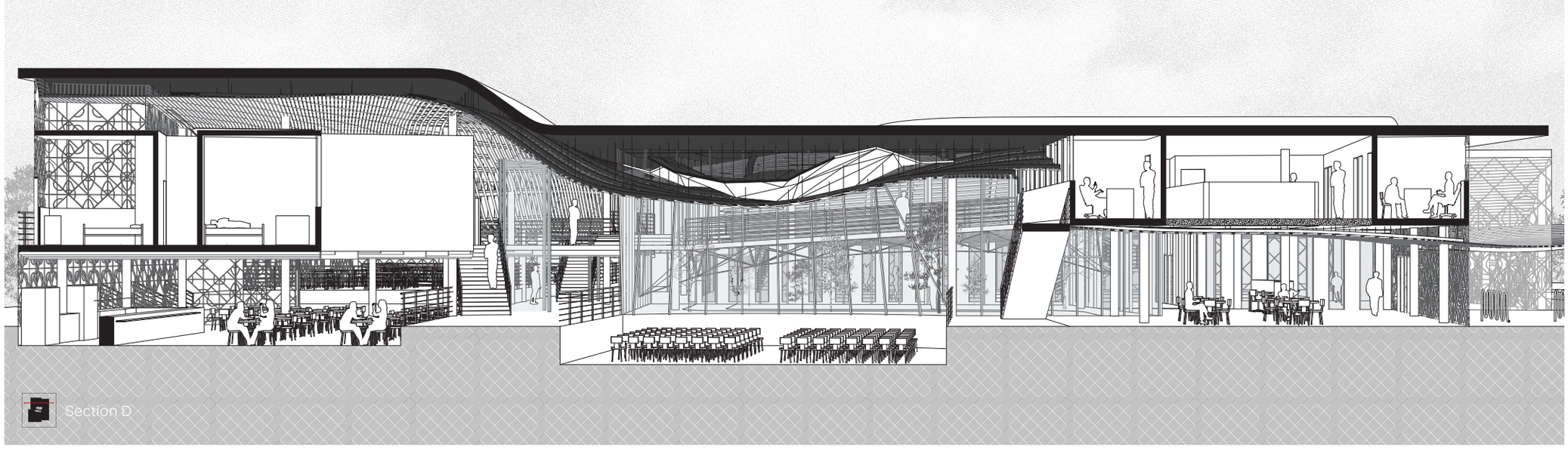


Section B



Section B with Aural Zones


Section C

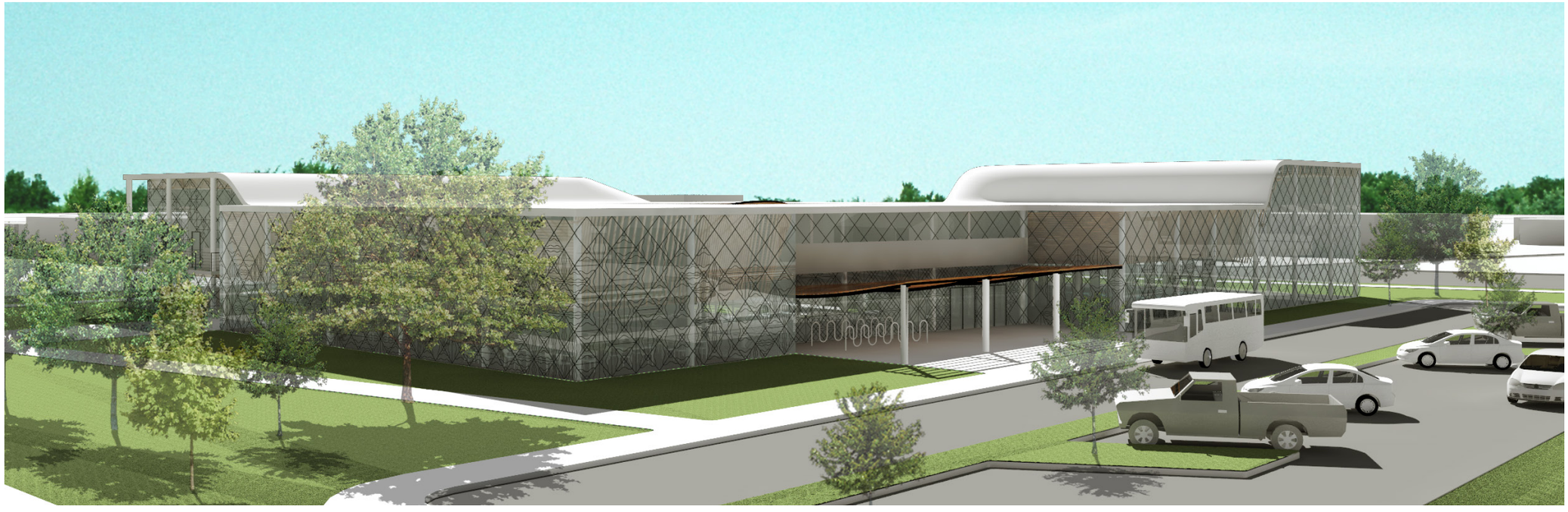

Section D

Southeast Meeting/Classroom Area

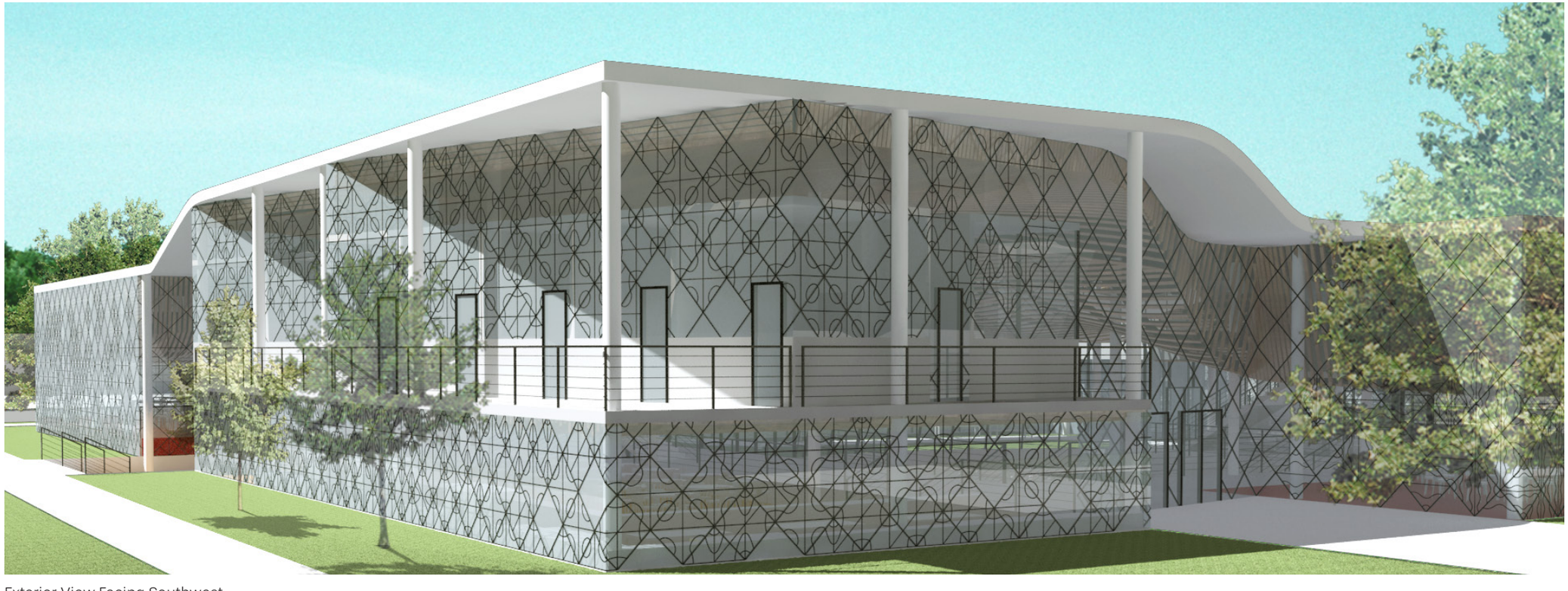
Northwest Meeting/Classroom Area and Front Entrance

Northeast Entrance

Courtyard/Pool Corridor

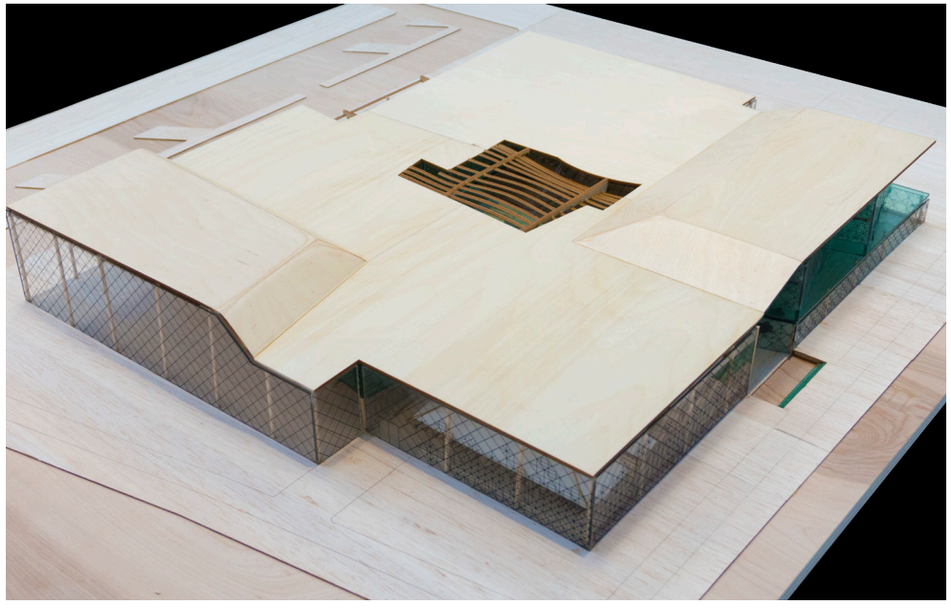


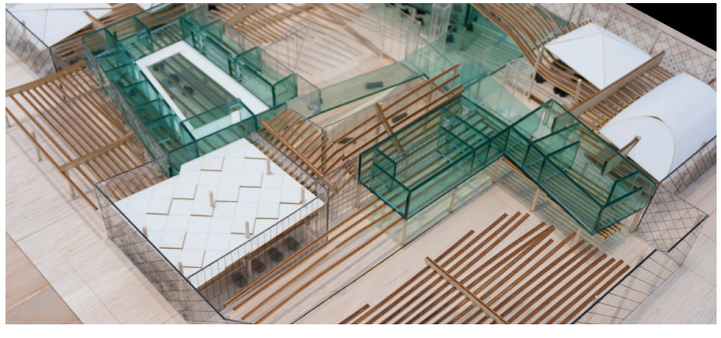
Exterior View Facing Southeast

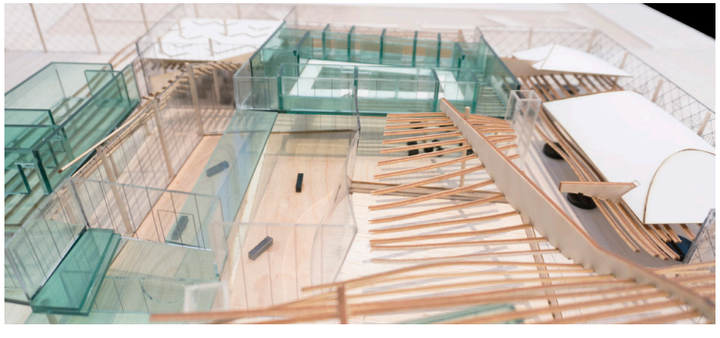


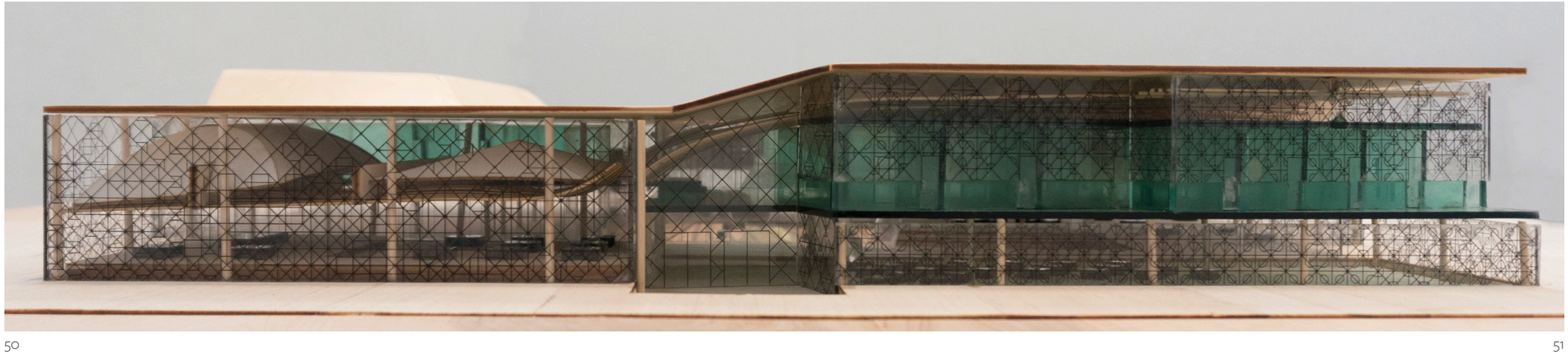
Exterior View Facing Southwest

Model Photos










The Spaces We Hear
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Michael Kapinus

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